# TFL 19 inventory audit

## Introduction

An inventory is conducted by the licensee of each Tree Farm Licence (TFL) in British Columbia every 10 to 30 years, using standards and procedures that are approved by the Ministry of Forests. Regular updates are undertaken to reflect changes in the timber volume due to growth and to depletions from harvesting and natural causes.

This report presents the results of an inventory audit performed within TFL 19 in 1999. Tree Farm Licence 19 is located on the west coast of Vancouver Island in the vicinity of Nootka Sound. It is bordered by the Strathcona Timber Supply Area and Strathcona Provincial Park to the east, Nootka Sound to the west, Canadian Forest Products Ltd.'s TFL 37 and Weyerhaeuser's TFL 39 to the north, and Clayoquot Sound to the south. The TFL is held by Doman-Western Lumber Ltd. and managed by Western Forests Limited. The TFL is administered from the Campbell River Forest District, as part of the Vancouver Forest Region. The total land base is 192 551 hectares, of which 153 655 hectares are considered to be productive forest

## Purpose of the audit and application of the results

It is often asked, "How accurate is the current inventory?" To answer this important question, the Ministry of Forests has developed an inventory audit methodology specifically designed to test the overall accuracy of estimates of the total standing volume in each timber supply area.

This inventory audit methodology entails sampling three primary components of the inventory: mature forests, immature forests, and non-forest areas.

The objective of the inventory audit program is to help identify TFLs or TSAs where the forest inventory needs attention. Enough samples are taken to ensure statistically reliable results for the TFL as a whole.

The amount of data collected, however, is not sufficient to make statistically reliable conclusions about specific strata within the TFL. For example, any overall differences, highlighted by the audit, could result from problems: with one tree species, from part of the land base (such as high elevation rather than lower elevation areas), from one age group of forest stands, or from a combination of these and other factors. As a consequence, general audit results cannot be used to adjust information for timber harvesting purposes since the audited area represents only a small portion of the total forested area in the TFL.

The audits provide information that may be useful to the Chief Forester when determining the allowable annual cut—offering a general assessment of the uncertainty associated with mature timber volumes, immature site index, and the non-forest classification. However, the audit results cannot justifiably be used to make specific adjustments to growth and yield and other information used in timber supply analyses and allowable annual cut determinations.

## Methods

### Current inventory

There are 34 TFLs in British Columbia, varying in size from approximately 8,500 hectares to 1 million hectares. Inventories of each TFL are conducted through a multistage process. Although the methodology varies within each TFL, all standards must be approved by the Ministry of Forests. New standards currently under development will ensure a consistent minimum standard for all TFLs. Generally, polygons are first delineated from 1:15 000-scale aerial photographs. Photo-interpretation is then used to produce data on a number of attributes for each polygon. These attributes include species composition, stand height, age, and crown closure. Timber volume is then estimated indirectly using the photo-interpreted variables and an empirical yield model. Other approaches to volume estimation, approved by the Ministry of Forests, may also be used.

To keep estimates current, inventories are regularly updated to account for forest growth and for depletions due to harvesting, fire, and the impact of insects and disease damage. Empirical yield models, such as the Ministry of Forests Variable Density Yield Prediction (VDYP) computer model, are used to update the inventory for forest growth. Field visitation, satellite imagery, and aerial photographs may be used to update the inventory for depletions.

### Inventory audit procedures

The inventory audit tests three components of the current inventory. The first component is the mature forested areas (forest stands older than 60 years). The inventory audit tests the accuracy of the mature timber volume as well as stand attributes (age, height and species composition). The second component tested is immature stands (younger than 60 years but older than the silvicultural classification of free growing). The audit tests the accuracy of the site growth potential (site

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index) and species composition assignment for these stands. The third component tested is the area classified as non-forest in the inventory, which includes areas such as lakes, gravel pits, and alpine meadows. The audit tests the accuracy of the photo-interpreted classification for this component.

**Mature component assessment criteria**

To test the mature component of the inventory, the existing inventory's estimate of the mean mature volume per hectare for the TFL (*the inventory volume*), is compared with a new estimate of the mean mature volume per hectare obtained from the audit samples (*the audit volume*). In most TFLs the inventory volume is assessed from base yield curves derived from the VDYP yield model.

The difference between these two estimates is called the total bias. A test is conducted on this bias to determine if it is statistically significant. This test establishes whether there are detectable differences between the audit volume estimate and the inventory volume estimate, for the total forested area of the TFL.

If the total bias is found to be statistically significant, further analyses are conducted to determine if the specific source of bias within the inventory is one of the following:

- *classification bias*: This is caused by incorrectly estimating the polygon attributes; or
- *model bias*: This is caused by poor prediction from the yield model, which was developed for large areas of the province and was not designed for specific management units.

In most TFLs the analysis used to determine the source of bias uses an estimate of the mean mature volume per hectare for the TFL called the ground attribute volume. This is calculated from audit sample attributes (stocking class and stand table estimates of species composition and stocking, and ground-based averages of top height and age), along with crown closure taken from the original map label, using the yield prediction model. The difference between the ground attribute volume estimate and the audit volume estimate approximates the bias associated with the yield model. The difference between the audit volume estimate and the inventory volume estimate not accounted for by the model bias approximates the bias associated with the inventory classification attributes. Once the source is identified, further analyses may be done on the inventory classification attributes or the yield model itself.

**Immature component assessment criteria**

Accuracy of the inventory classification for immature stands is tested by examining the site index and species composition assignment. Since the immature forest stand site index provides an estimate of site productivity, its accuracy affects the projection of long-term harvest levels.

Data gathered is examined to determine how closely the audit and inventory site indices match for individual samples. and to explore potential trends.

**Non-forest component assessment criteria**

The audit test for the non-forest component of the inventory assesses the accuracy of the non-forest classification assignment. An air photo interpreter certified by the Ministry of Forests compares the non-forest inventory classification to a suitably-scaled forest cover aerial photograph. Classification accuracy is rated using a point scoring scheme to determine an overall accuracy percentage. The acceptance criteria for this test is 85% or higher.

## TFL 19 audit sampling procedures

The TFL 19 sample used updated maps based on the most recent inventory. A list of all polygons identified on the maps was produced and sorted on a number of stand characteristics (site quality, age, and species group). Polygons were systematically selected from this list by a process designed to produce a representative sample of the TFL.

For the mature forested component of the inventory audit, a random sample of 50 forested polygons from the total forested area in the TFL was selected for sampling.

Up to 4 full-measure prism plots and 5 count plots were established within each of the 50 sample polygons. The plots were located systematically, using a square grid and a random start point. The grid interval varied with polygon size. To reduce sample costs for large or irregular polygons, a portion of the polygon was randomly selected for ground sampling. A total of about 200 full-measure and 250 count plots were established. Field data collection and compilation followed Ministry of Forests cruising and cruise compilation procedures. The objective was to obtain audit volumes that were comparable (in terms of utilization standards and merchantability definitions) to the inventory volumes produced by the licensee.

Since the licensee used VDYP as their yield model, the audit volumes were compared with inventory volumes generated using VDYP. The VDYP system produces net merchantable volume per hectare defined as stem volume inside bark of all live trees excluding a 10 cm diameter inside-bark top and a 30 cm high stump. Dead potential and veteran trees are not included in the VDYP system volume estimates. To be consistent with the utilization standards applied by the licensee in their timber supply analysis, the volume was calculated for a utilization standard defined as all live trees of 17.5+ cm dbh. Volumes were compiled net of decay, waste and breakage, as estimated from Ministry loss factors.

The audit volume estimates were then compared to the inventory volume estimates from VDYP to test the validity of the current inventory. A paired sample t-test was used to test for significant differences. The precision of the inventory volume estimates—how well the inventory volume estimate

corresponds to the audit volume estimate on a sample-by-sample basis—was assessed by measuring the statistical correlation. The data was then post-stratified to detect trends related to the operable and inoperable forested land base distribution of the sampled polygons.

From the immature forested component, a random sample of 20 polygons was selected for sampling. Up to 9 inventory ground calls were established within each of the 20 sample polygons. The plots were located systematically, using a square grid and a random start point, similar to the mature volume component. A total of about 180 ground calls were established and data collection followed the standard Ministry of Forests inventory ground call procedures.

Lack of time and resources did not permit completion of the assessment of the non-forest component of the inventory.

## Inventory audit results

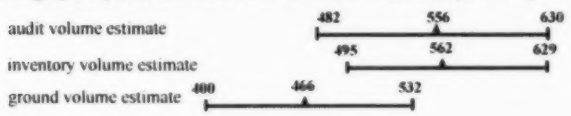
### Analysis of mature volumes

Overall results of the inventory audit for mature volume in the total forested area of the TFL 19 are summarized in Table 1.

**TABLE 1. Statistics for the audit, inventory and ground attribute volume estimates (17.5+ cm dbh utilization net decay, waste & breakage), TFL 19**

| | Audit volume estimate | Inventory volume estimate | Ground attribute volume estimate |
|---|---|---|---|
| Number of samples | 50 | 50 | 40 |
| Mean ($m^3$/ha) | 556 | 562 | 466 |
| Coefficient of variation (%) | 47 | 42 | 44 |
| Standard error | 36.7 | 33.3 | 32.7 |
| Sampling error (%) | 13.3 | 11.9 | 14.2 |
| 95% confidence interval | 482 - 630 | 495 - 629 | 400 - 532 |
| Correlation coefficient | r = 0.444 | | |
| Ratio of means (audit/inventory): | 0.99 | | |

**Bar graph representation of 95% confidence intervals (in $m^3$/ha):**




The correlation coefficient of 0.444 for the audit and inventory volume estimates indicates a moderate relationship among the individual samples in this stratum. There is a 6 $m^3$/ha difference between the mean inventory estimate for mature volume (562 $m^3$/ha) and the audit estimate (556 $m^3$/ha). A paired-sample *t*-test determined that, for the mature component of the total forested area of the TFL, a statistical difference could not be detected, 19 times out of 20. The 95% confidence interval for the mean paired difference is –81 to 68 $m^3$/ha.

Although there was no statistically significant difference between the two estimates, the ground attribute volume was calculated from the VDYP yield model so that any potential underlying sources of bias could be identified.

Ground height was not available for 10 samples; therefore ground attribute volume estimates are based on 40 samples. For the ground attribute volume comparison, mean audit and inventory volumes were calculated based on the same set of 40 samples. The difference between the mean ground attribute volume (466 $m^3$/ha) and the mean audit volume (554 $m^3$/ha) was 87 $m^3$/ha. The difference between the mean inventory volume (527 $m^3$/ha) and the mean ground attribute volume was 61 $m^3$/ha. This suggests that the apparent lack of total bias could actually be the result of offsetting biases associated with the VDYP yield model and the inventory classification attribute. However, any conclusions regarding model and attribute bias must be viewed with caution because of the relatively large number of samples with missing values for ground attribute volume.

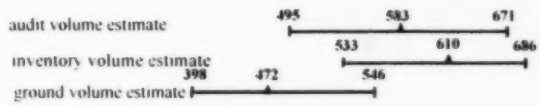
### Analysis of operable and inoperable volumes

To provide audit results more likely to be applicable to the timber supply planning process, an approximation was made of the forested areas considered currently available for timber harvesting (operable areas). The audit results were post-stratified based on this approximation. Results of the inventory audit for forested samples in the operable areas of TFL 19 are given in Table 2.

**TABLE 2. Statistics for the audit, inventory and ground attribute volume estimates (17.5+ cm dbh utilization net decay, waste & breakage), TFL 19 operable forested areas.**

| | Operable Audit volume estimate | Operable Inventory volume estimate | Operable Ground attribute volume estimate |
|---|---|---|---|
| Number of samples | 36 | 36 | 29 |
| Mean ($m^3$/ha) | 583 | 610 | 472 |
| Coefficient of variation (%) | 45 | 37 | 41 |
| Standard error | 43.4 | 37.6 | 36.0 |
| Sampling error (%) | 15.1 | 12.5 | 15.6 |
| 95% confidence interval | 495 - 671 | 533 - 686 | 398 - 546 |
| Correlation coefficient | | r = 0.329 | |
| Ratio of means (audit/inventory): | | 0.96 | |

**Bar graph representation of 95% confidence intervals (in $m^3$/ha):**



For the 36 samples located within the operable forested area, the mean audit volume estimate is 583 $m^3$/ha and mean inventory volume estimate is 610 $m^3$/ha. The difference of 27 $m^3$/ha between the two estimates is not statistically significant 19 times out of 20.

The ground attribute volume was calculated to further examine the source of the total bias in the operable area. This analysis suggested that both the VDYP model and the classification attributes contribute in an offsetting manner to the total bias. However, these results must be viewed with caution since ground height and hence ground attribute volumes were not available for 7 of the 36 samples in the operable forested area.

There were only 14 samples that were located within the inoperable forested area in TFL 19. The sample size was too small to allow any meaningful comparisons to be made. Because of the high variability and restrictive nature of conclusions associated with small sample size, volume estimates from the inoperable forested areas are not shown.

**Analysis of immature inventory classification**

Out of the 20 stands sampled in the field, one sample was too young to assess a ground site index. Of the remaining 19 stands, the inventory correctly identified site index within ±5 m of the audit site index for 10 stands. The inventory site index was more than 5 m lower than the audit site index for 2 stands, and more than 5 m higher for 7 stands. Leading species was correctly identified for 45% of the sampled stand.

**Analysis of non-forest inventory classification**

Due to staff constraints and lack of funding, the assessment of the non-forest classification was not completed.

## Discussion and conclusions

The objective of the inventory audit in the TFL 19 was to assess the overall accuracy of the current inventory. The mature and immature components were tested but lack of time and resources did not permit assessment of the non-forest component.

Audit results for the mature component of the inventory for the TFL 19 suggest that the inventory is statistically acceptable. Subsequent analysis of post-stratified data also shows a similar trend in the operable forested areas. The results of this audit will be reviewed by Timber Supply Branch.

Audit results for the immature component of the inventory suggest that site index and species composition assignment in young stands may not be accurate. The licensee recognizes some of deficiencies in the current inventory and is planning on upgrading the inventory to the new Vegetation Resources Inventory standards.

## Glossary

**accuracy**: A measure of how close an estimate is to the true value.

**allowable annual cut**: The rate of timber harvesting specified for an area of land.

**analysis unit**: The basic building blocks around which inventory data and other information are organized for use in forest planning models, typically involving specific tree species or type groups that are further defined by site class, geographic location or similarity of management regimes.

**bias**: The quality of a measurement device or procedures that tends to result in a systematic misrepresentation of what is being measured.

**coefficient of variation**: A relative measure of variation within a population, calculated as the ratio between the standard deviation and the mean value.

**confidence interval**: The range of values within which the population parameter is expected to lie.

**confidence level**: The estimated probability that a population parameter lies within a given confidence interval.

**correlation coefficient**: A measure of the relationship between two variables. A value of 0 for the correlation coefficient indicates a random relationship, whereas a value of ±1 indicates a perfect positive or negative linear correspondence.

**dead potential trees**: Standing or down dead timber which is estimated to contain at least 50% of its original gross volume in sound wood.

**diameter at breast height (dbh)**: The stem diameter (outside-bark) of a tree measured at breast height (1.3 metres above the point of germination) to the nearest millimetre.

**field visitations**: Ground-level field procedures designed to provide physical verification of polygon inventory attributes.

**free-growing (crop)**: A crop of healthy trees of a commercially valuable species, the growth of which is not impeded by competition from plants, shrubs, or other trees.

**inoperable lands**: Lands that are unsuited for timber production now and in the foreseeable future because of their topography, inaccessible location, low value of timber stands, or designation for uses incompatible with timber production.

**mean**: The average value of a set of observations.

**polygon**: A portion of land area, delineated on mid-scale aerial photographs, of "like" or uniform land cover type.

**pre-inventory assessments**: Inventory activities to evaluate the existing forest inventory as a basis for deciding whether to re-inventory or update the current inventory.

and to document the existing inventory, maps, and photos to support the execution of the reinventory or update if required.

**public sustained yield units (PSYU)**: A portion of a TSA; an area of Crown land, usually a natural topographic unit determined by drainage areas, managed for sustained yield by the Crown through the Ministry of Forests. It includes all Crown lands within the currently established boundaries of the unit and excludes federal lands, provincial parks, experimental forest reserves, gazetted watersheds and tree farm licenses.

**ratio estimate**: The ratio between two different estimates.

**representative**: The quality of a sample having the same characteristics as the population from which it is selected.

**sampling**: The process of selecting observations.

**sampling error**: The error attributed to sampling procedures.

**significant difference**: The results of a statistical test comparing either two or more estimates, or an estimate to a fixed value. If the difference is too large to be attributed to chance, the difference is said to be statistically significant.

**site index**: An expression of the forest site quality of a stand, at a specified age, based either on the site height, or on the top height, which is a more objective measure.

**standard error**: An expression of the absolute variability of an estimate.

**standard deviation**: A measure of the variation of the population.

**timber supply analysis**: An assessment of future timber supplies over long planning horizons (more than 200 years) by using timber supply models for different scenarios identified in the planning process.

**timber supply area (TSA)**: An area defined by an established pattern of wood flow from management units to the primary timber-using industries.

**tree farm license (TFL)**: Privately managed Sustained Yield Units; designed to enable owners of Crown-granted forest lands and old temporary tenures or the timber licenses which replace them, to combine these with enough unencumbered Crown land to form self-contained sustained yield management units.

**variable density yield prediction (VDYP) model**: An empirical yield-prediction system for natural stands based on data collected in temporary inventory sample plots (TSPs) and natural, permanent growth sample plots (PSPs). VDYP predicts volume (net decay) and diameters at four utilization levels using stand height, age, and density. The aerial approach uses crown closure as the density measure.

**veteran trees**: Mature living trees which are remnants of an older stand.

## For more information

For more information or to obtain other inventory audit reports, contact: Director, Resources Inventory Branch, 722 Johnson Street, Victoria, BC, Canada V8W 3E7, Phone 250-387-1314, fax 250-387-5999, or visit our web site at http://www.for.gov.bc.ca/resinv/

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# Summary of results for all mature samples: VDYP comparison

***Table 1. Means and confidence intervals for VDYP comparison: all mature samples***

| *Attribute* | *n*[1] | *mean* | *95% CI* | *Sampling error (% of mean)* |
|---|---|---|---|---|
| Inventory vol/ha (VDYP, 17.5cm+ dbh, net dwb) | 50 | 562 | 495 – 629 | 11.9% |
| Audit vol/ha (compiled, TC 1&2, 17.5cm+ dbh, net dwb) | 50 | 556 | 482 – 630 | 13.3% |
| "Ground attribute" vol/ha[2] (VDYP, 17.5cm+ dbh, net dwb) | 40 | 466 | 400 – 532 | 14.2% |
| Ground height (m) | 40 | 30.1 | 26.9 – 33.2 | 10.6% |
| Inventory height (m) | 50 | 33.0 | 30.6 – 35.4 | 7.3% |
| Ground age (yrs) | 40 | 323 | 271 – 376 | 16.2% |
| Inventory age (yrs) | 50 | 267 | 247 – 287 | 7.6% |

[1] Note that ground height and age were not available for 10 samples.

[2] "Ground attribute" volume is calculated from audit sample attributes (i.e. "ground" attributes: stock and stand table estimates of species composition and stocking, and ground-based averages of top height and age), along with crown closure taken from the original map label, using the VDYP yield prediction model.

## Summary of results for all mature samples: VDYP comparison (cont'd)

***Table 2. Ratios, t-tests and correlations for VDYP comparison: all mature samples***

| *Attributes compared* | *n*[3] | *Ratio*[4] *(95% CI)* | *Sampling error % for ratio* | *Mean paired difference (p-value*[5]*)* | *Correlation (p-value*[6]*)* |
|---|---|---|---|---|---|
| Audit volume / map volume (TC 1&2, 17.5cm+ dbh, net dwb) | 50 | 0.99<br>0.87 – 1.11 | 12% | -6<br>(0.868) | 0.444<br>(0.001) |
| Audit volume / "ground attribute" vol (TC 1&2, 17.5cm+ dbh, net dwb) ≈ "Model bias"[7] | 40 | 1.19<br>1.02 – 1.35 | 14% | 87<br>(0.018) | 0.545<br>(<0.001) |
| "Ground attribute" volume / map volume (TC 1&2, 17.5cm+ dbh, net dwb) ≈ "Attribute bias" | 40 | 0.88<br>0.78 – 0.98 | 11% | -61<br>(0.033) | 0.649<br>(<0.001) |
| Ground height / map height | 40 | 0.95<br>0.75 – 1.17 | 22% | -1.4<br>(0.218) | 0.720<br>(<0.001) |
| Ground age / map age | 40 | 1.25<br>0.97 – 1.53 | 23% | 65<br>(0.003) | 0.611<br>(<0.001) |

[3] Statistics for the comparisons in this table are based on matched pairs of samples. If one of the values is not available for a particular sample (e.g. inventory height is available but ground height is missing) then the sample is not included in the mean used to compute the ratio.

[4] "Ratio" is a ratio of means (e.g. mean ground height divided by mean inventory height).

[5] In this two-sided t-test, the null hypothesis is that the mean paired difference between the two attributes is zero. If the p-value indicated is less than a specified significance level (0.05 or 5% is used as a standard), then the null hypothesis is rejected and the test is said to have detected a statistically significant difference between the attributes. P-values greater than 0.05 indicate that the test was not able to detect a significant difference between the attributes with this sample.

[6] Correlation indicates the degree of the linear relationship between two variables. In the test of significance for the correlation coefficient, a p-value less than or equal to 0.05 indicates a statistically significant correlation.

[7] See Table 1 footnotes for a description of how "ground attribute" volume is calculated. The difference between the ground attribute volume estimate and the audit volume estimate *approximates* the bias associated with the yield model. The difference between the ground attribute volume estimate and the inventory volume estimate *approximates* the bias associated with the inventory classification attributes. These two bias components comprise the *total bias* in the inventory.

## Graphs for all mature samples (letter symbols are map GTGs)

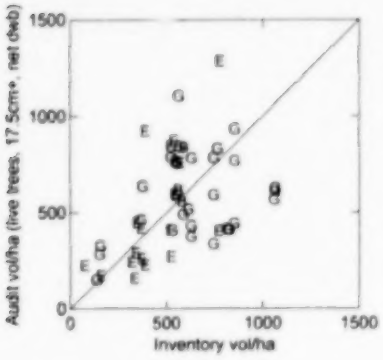



Fig. 1: Audit volume (TC 1&2, 17.5cm+ dbh, net dwb) vs. map volume

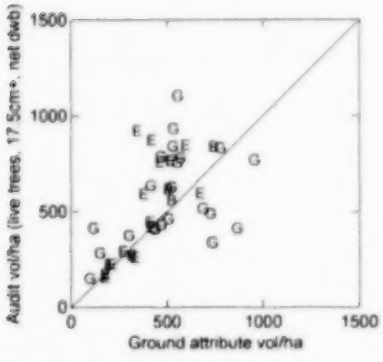



Fig. 2: Audit volume vs. "ground attribute" volume (TC 1&2, 17.5cm+ dbh, net dwb)
≈ "Model bias"

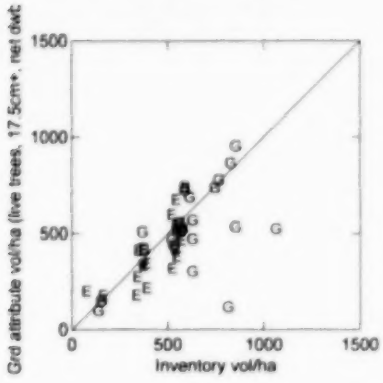



Fig. 3: "Ground attribute" volume vs. map volume (TC 1&2, 17.5cm+ dbh, net dwb)
≈ "Attribute bias"

## Graphs for all mature samples (letter symbols are map GTGs)

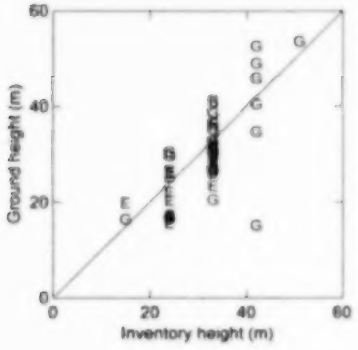



Fig. 4: Ground height vs. map height

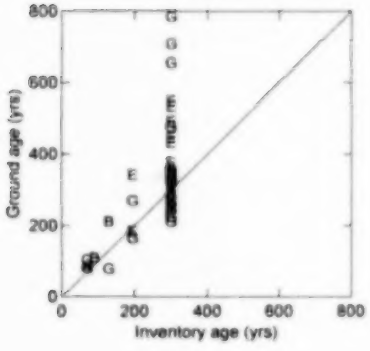



Fig. 5: Ground age vs. map age

## Summary of results for all mature samples: Old TSR comparison

***Table 3. Means and confidence intervals for old TSR volume comparison[8]: all mature samples***

| *Attribute* | *n[9]* | *mean* | *95% CI* | *Sampling error (% of mean)* |
|---|---|---|---|---|
| Inventory vol/ha (VDYP, 17.5cm+ dbh, net decay) | 50 | 618 | 546 – 691 | 11.7% |
| "Adjusted" inventory vol/ha (1.09 * inventory vol/ha)[10] | 50 | 674 | 595 – 753 | 11.7% |
| Audit vol/ha (compiled, TC 1&2, 17.5cm+ dbh, net dwb) | 50 | 556 | 482 – 630 | 13.3% |
| Audit vol/ha (compiled, TC 1,2,3&5, 17.5cm+ dbh, net dwb) | 50 | 606 | 534 – 679 | 12.0% |
| AVL vol/ha (17.5cm+ dbh, net dwb, dead potential wood included[??]) | 36 | 584 | 514 – 655 | 12.1% |

***Table 4. Ratios, t-tests and correlations for old TSR volume comparison: all mature samples***

| *Attributes compared* | *n[11]* | *Ratio[12] (95% CI)* | *Sampling error % for ratio* | *Mean paired difference (p-value[13])* | *Correlation (r -value[14])* |
|---|---|---|---|---|---|
| Audit volume / "adj'd" map volume (TC 1&2, 17.5cm+ dbh, net dwb) | 50 | 0.83<br>0.72 – 0.93 | 13% | -118<br>(0.005) | 0.449<br>(0.001) |
| Audit volume / "adj'd" map volume" (TC 1,2,3&5, 17.5cm+ dbh, net dwb) | 50 | 0.90<br>0.79 – 1.01 | 12% | -67<br>(0.093) | 0.462<br>(0.001) |
| Audit volume / AVL volume (TC 1&2, 17.5cm+ dbh, net dwb) | 36 | 0.96<br>0.81 – 1.11 | 15% | -23<br>(0.597) | 0.398<br>(0.016) |
| Audit volume / AVL volume (TC 1, 2,3&5, 17.5cm+ dbh, net dwb) | 36 | 1.04<br>0.89 – 1.20 | 15% | 25<br>(0.559) | 0.396<br>(0.017) |
| AVL volume (17.5cm+, net dwb) / map volume (VDYP, 17.5cm+ dbh, net decay) | 36 | 0.95<br>0.88 – 1.03 | 8% | -28<br>(0.262) | 0.771<br>(<0.001) |

[8] Based on AU volumes corresponding to last timber supply analysis.
[9] Note that AVL volume is missing for some samples. For other samples, ground height and age were not available.
[10] In the last timber supply analysis for TFL 19, volumes were generated by applying a 1.09 ratio adjustment factor to VDYP volumes net decay, to adjust the inventory volumes for waste, breakage and error associated with the VDYP model. The adjustment factor was developed from the relationship between AVL volumes and VDYP volumes for the areas where AVL volumes were available.
[11] Statistics for the comparisons in this table are based on matched pairs of samples. If one of the values is not available for a particular sample (e.g. inventory height is available but ground height is missing) then the sample is not included in the mean used to compute the ratio.
[12] "Ratio" is a ratio of means (e.g. mean ground height divided by mean inventory height).
[13] Refer to table 2 footnote for interpretation of p-values.
[14] Refer to table 2 footnote for interpretation of p-values.

## Graphs for all mature samples: Old TSR comparison

(letter symbols are map GTGs)

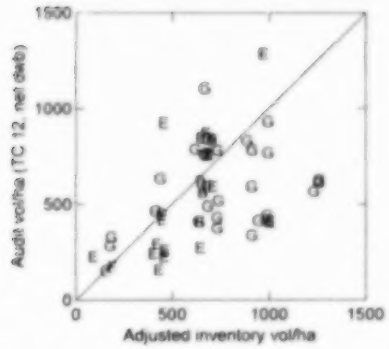



Fig. 6: Audit volume (TC 1&2, 17.5cm+ dbh, net dwb) vs. "adjusted" map volume

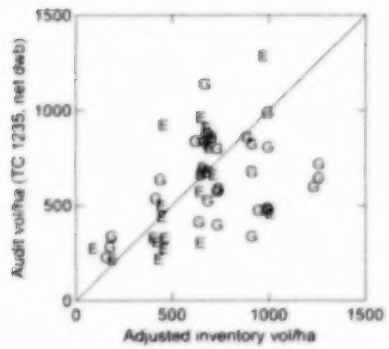



Fig. 7: Audit volume (TC 1,2,3&5, 17.5cm+ dbh, net dwb) vs. "adjusted" map volume"

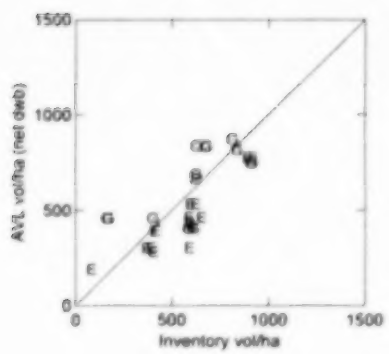



Fig. 8: AVL volume (17.5cm+, net dwb) vs. map volume (VDYP, 17.5cm+ dbh, net decay)

## Graphs for all mature samples: Old TSR comparison

(letter symbols are map GTGs)

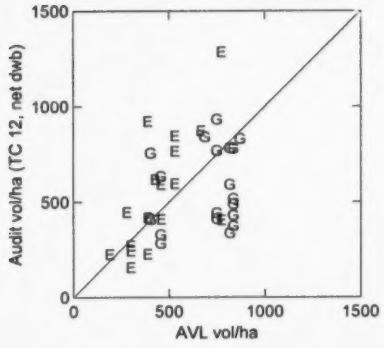



Fig. 9: Audit volume (TC 1&2, 17.5cm+ dbh, net dwb) vs. AVL volume

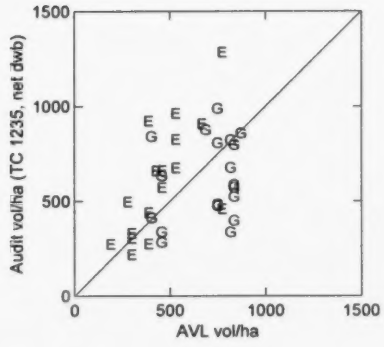



Fig. 10: Audit volume (TC 1,2,3&5, 17.5cm+ dbh, net dwb) vs. AVL volume

## Summary of results for all OPERABLE (100% operable only) samples: VDYP comparison

***Table 5. Means and confidence intervals for VDYP comparison: 100% operable samples***

| *Attribute* | *n* | *mean* | *95% CI* | *Sampling error (% of mean)* |
|---|---|---|---|---|
| Inventory vol/ha (VDYP, 17.5cm+ dbh, net dwb) | 27 | 624 | 526 – 721 | 15.6% |
| Audit vol/ha (compiled, TC 1&2, 17.5cm+ dbh, net dwb) | 27 | 563 | 457 – 668 | 18.8% |
| "Ground attribute" vol/ha (VDYP, 17.5cm+ dbh, net dwb) | 22 | 452 | 363 – 542 | 19.8% |
| Ground height (m) | 22 | 29.8 | 25.2 – 34.5 | 15.6% |
| Inventory height (m) | 27 | 35.3 | 31.8 – 38.8 | 9.9% |
| Ground age (yrs) | 22 | 304 | 244 – 364 | 19.7% |
| Inventory age (yrs) | 27 | 274 | 249 – 298 | 8.8% |

***Table 6. Ratios, t-tests and correlations for VDYP comparison: 100% operable samples***

| *Attributes compared* | *n* | *Ratio (95% CI)* | *Sampling error % for ratio* | *Mean paired difference (p-value)* | *Correlation (p-value)* |
|---|---|---|---|---|---|
| Audit volume / map volume (TC 1&2, 17.5cm+ dbh, net dwb) | 27 | 0.90<br>0.75 – 1.05 | 16% | -61<br>(0.249) | 0.454<br>(0.017) |
| Audit volume / "ground attribute" vol (TC 1&2, 17.5cm+ dbh, net dwb) ≈ "Model bias" | 22 | 1.16<br>0.94 – 1.38 | 19% | 72<br>(0.129) | 0.543<br>(0.009) |
| "Ground attribute" volume / map volume (TC 1&2, 17.5cm+ dbh, net dwb) ≈ "Attribute bias" | 22 | 0.80<br>0.65 – 0.95 | 19% | -112<br>(0.022) | 0.509<br>(0.016) |
| Ground height / map height | 22 | 0.90<br>0.61 – 1.19 | 32% | -3.2<br>(0.074) | 0.655<br>(0.001) |
| Ground age / map age | 22 | 1.14<br>0.81 – 1.46 | 29% | 36<br>(0.119) | 0.646<br>(0.001) |

## Summary of results for all OPERABLE (100% operable only) samples: Old TSR volume comparison

***Table 7. Means and confidence intervals: 100% operable samples***

| *Attribute* | *n* | *mean* | *95% CI* | *Sampling error (% of mean)* |
|---|---|---|---|---|
| Inventory vol/ha (VDYP, 17.5cm+ dbh, net decay) | 27 | 689 | 583 – 794 | 15.3% |
| "Adjusted" inventory vol/ha (1.09 * inventory vol/ha)[15] | 27 | 751 | 636 – 865 | 15.3% |
| Audit vol/ha (compiled, TC 1&2, 17.5cm+ dbh, net dwb) | 27 | 563 | 457 – 668 | 18.8% |
| Audit vol/ha (compiled, TC 1,2,3&5, 17.5cm+ dbh, net dwb) | 27 | 613 | 509 – 717 | 17.0% |
| AVL vol/ha (17.5cm+ dbh, net dwb, dead potential wood included??) | 18 | 817 | 508 – 726 | 17.7% |

***Table 8. Ratios, t-tests and correlations: 100% operable samples***

| *Attributes compared* | *n* | *Ratio (95% CI)* | *Sampling error % for ratio* | *Mean paired difference (p-value)* | *Correlation (p-value)* |
|---|---|---|---|---|---|
| Audit volume / "adj'd" map volume (TC 1&2, 17.5cm+ dbh, net dwb) | 27 | 0.75<br>0.62 – 0.88 | 18% | -188<br>(0.002) | 0.465<br>(0.015) |
| Audit volume / "adj'd" map volume" (TC 1,2,3&5, 17.5cm+ dbh, net dwb) | 27 | 0.82<br>0.68 – 0.95 | 17% | -137<br>(0.021) | 0.457<br>(0.017) |
| Audit volume / AVL volume (TC 1&2, 17.5cm+ dbh, net dwb) | 18 | 0.95<br>0.72 – 1.17 | 24% | -32 (0.635) | 0.426<br>(0.078) |
| Audit volume / AVL volume (TC 1, 2,3&5, 17.5cm+ dbh, net dwb) | 18 | 1.03<br>0.80 – 1.25 | 22% | 16<br>(0.806) | 0.428<br>(0.076) |
| AVL volume (17.5cm+, net dwb) / map volume (VDYP, 17.5cm+ dbh, net decay) | 18 | 0.92<br>0.81 – 1.02 | 11% | -56 (0.117) | 0.778<br>(<0.001) |

[15] The last TSR report for TFL 19 used a 1.09 ratio adjustment factor to adjust the inventory volumes for waste, breakage and error associated with VDYP. The adjustment factor was developed from the relationship between AVL volumes and VDYP volumes.

## Summary of results for all OPERABLE (including partially operable) samples VDYP comparison

***Table 9: Means and confidence intervals for VDYP comparison: operable and partially operable samples***

| *Attribute* | *n* | *mean* | *95% CI* | *Sampling error (% of mean)* |
|---|---|---|---|---|
| Inventory vol/ha (VDYP, 17.5cm+ dbh, net dwb) | 36 | 610 | 533 – 686 | 12.5% |
| Audit vol/ha (compiled, TC 1&2, 17.5cm+ dbh, net dwb) | 36 | 583 | 495 – 671 | 15.1% |
| "Ground attribute" vol/ha (VDYP, 17.5cm+ dbh, net dwb) | 29 | 472 | 398 – 546 | 15.6% |
| Ground height (m) | 29 | 30.2 | 26.6 – 33.9 | 12.1% |
| Inventory height (m) | 36 | 34.8 | 32.0 – 37.6 | 8.1% |
| Ground age (yrs) | 29 | 295 | 244 – 345 | 17.2% |
| Inventory age (yrs) | 36 | 268 | 244 – 292 | 8.9% |

***Table 10. Ratios, t-tests and correlations for VDYP comparison: operable and partially operable samples***

| *Attributes compared* | *n* | *Ratio (95% CI)* | *Sampling error % for ratio* | *Mean paired difference (p-value)* | *Correlation (p-value)* |
|---|---|---|---|---|---|
| Audit volume / map volume (TC 1&2, 17.5cm+ dbh, net dwb) | 36 | 0.96<br>0.82 – 1.10 | 15% | -27<br>(0.575) | 0.329<br>(0.050) |
| Audit volume / "ground attribute" vol (TC 1&2, 17.5cm+ dbh, net dwb) ≈ "Model bias" | 29 | 1.19<br>0.98 – 1.41 | 18% | 92<br>(0.059) | 0.389<br>(0.037) |
| "Ground attribute" volume / map volume (TC 1&2, 17.5cm+ dbh, net dwb) ≈ "Attribute bias" | 29 | 0.84<br>0.72 – 0.96 | 14% | -89<br>(0.018) | 0.553<br>(0.002) |
| Ground height / map height | 29 | 0.93<br>0.68 – 1.17 | 27% | -2.4<br>(0.076) | 0.677<br>(<0.001) |
| Ground age / map age | 29 | 1.13<br>0.85 – 1.42 | 25% | 34<br>(0.064) | 0.704<br>(<0.001) |

## Graphs for operable samples: VDYP comparison

(letter symbols are map GTGs)

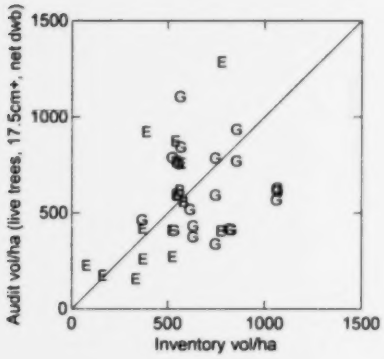



Fig. 11: Audit volume (TC 1&2, 17.5cm+ dbh, net dwb) vs. map volume

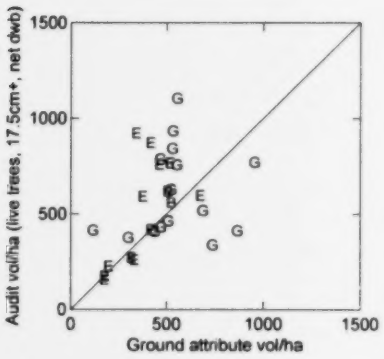



Fig. 12: Audit volume vs. "ground attribute" volume (TC 1&2, 17.5cm+ dbh, net dwb)
≈ "Model bias"

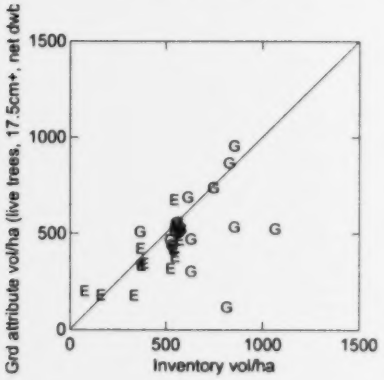



Fig. 13: "Ground attribute" volume vs. map volume (TC 1&2, 17.5cm+ dbh, net dwb)
≈ "Attribute bias"

## Graphs for operable samples (letter symbols are map GTGs)

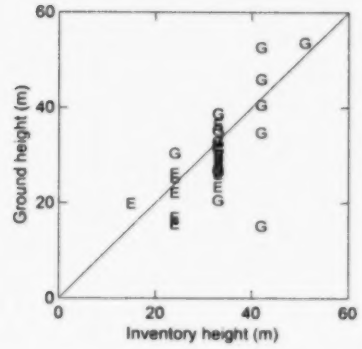



Fig. 14: Ground height vs. map height

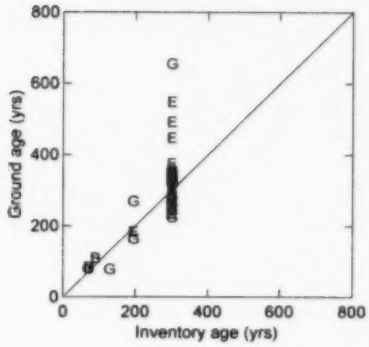



Fig. 15: Ground age vs. map age

## Summary of results for all OPERABLE (including partially operable) samples:
## Old TSR volume comparison

***Table 11: Means and confidence intervals for old TSR volume comparison: operable and partially operable samples***

| *Attribute* | *n* | *mean* | *95% CI* | *Sampling error (% of mean)* |
|---|---|---|---|---|
| Inventory vol/ha (VDYP, 17.5cm+ dbh, net decay) | 36 | 672 | 589 – 754 | 12.3% |
| "Adjusted" inventory vol/ha (1.09 * inventory vol/ha)[16] | 36 | 732 | 642 – 822 | 12.3% |
| Audit vol/ha (compiled, TC 1&2, 17.5cm+ dbh, net dwb) | 36 | 583 | 495 – 671 | 15.1% |
| Audit vol/ha (compiled, TC 1,2,3&5, 17.5cm+ dbh, net dwb) | 36 | 638 | 552 – 724 | 13.5% |
| AVL vol/ha (17.5cm+ dbh, net dwb, dead potential wood included??) | 25 | 595 | 509 – 681 | 14.4% |

***Table 12. Ratios, t-tests and correlations for old TSR volume comparison: operable and partially operable samples***

| *Attributes compared* | *n* | *Ratio (95% CI)* | *Sampling error % for ratio* | *Mean paired difference (p-value)* | *Correlation (p-value)* |
|---|---|---|---|---|---|
| Audit volume / "adj'd" map volume (TC 1&2, 17.5cm+ dbh, net dwb) | 36 | 0.80<br>0.67 – 0.92 | 16% | -149<br>(0.006) | 0.333<br>(0.048) |
| Audit volume / "adj'd" map volume" (TC 1,2,3&5, 17.5cm+ dbh, net dwb) | 36 | 0.87<br>0.74 – 1.00 | 15% | -95 (0.067) | 0.336<br>(0.045) |
| Audit volume / AVL volume (TC 1&2, 17.5cm+ dbh, net dwb) | 25 | 0.99<br>0.79 – 1.18 | 20% | -8<br>(0.882) | 0.313<br>(0.128) |
| Audit volume / AVL volume (TC 1, 2,3&5, 17.5cm+ dbh, net dwb) | 25 | 1.07<br>0.88 – 1.27 | 18% | 44<br>(0.432) | 0.326<br>(0.112) |
| AVL volume (17.5cm+, net dwb) / map volume (VDYP, 17.5cm+ dbh, net decay) | 25 | 0.90<br>0.83 – 0.98 | 8% | -65<br>(0.016) | 0.811<br>(<0.001) |

[16] The last TSR report for TFL 19 used a 1.09 ratio adjustment factor to adjust the inventory volumes for waste, breakage and error associated with VDYP. The adjustment factor was developed from the relationship between AVL volumes and VDYP volumes.

## Graphs for operable samples: Old TSR comparison (letter symbols are map GTGs)

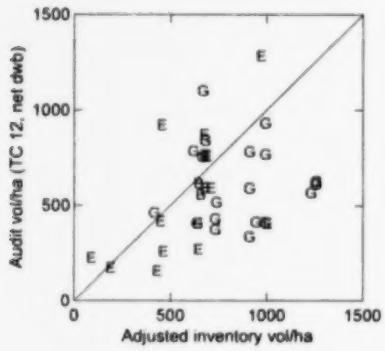



Fig. 16: Audit volume (TC 1&2, 17.5cm+ dbh, net dwb) vs. "adjusted" map volume

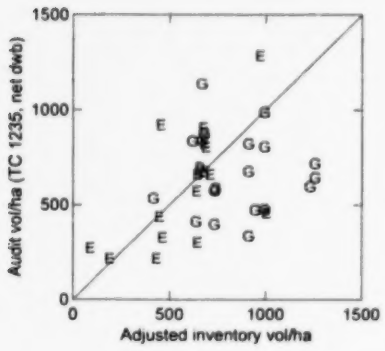



Fig. 17: Audit volume (TC 1,2,3&5, 17.5cm+ dbh, net dwb) vs. "adjusted" map volume"

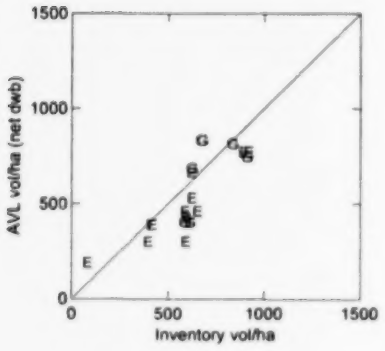



Fig. 18: AVL volume (17.5cm+, net dwb) vs. map volume (VDYP, 17.5cm+ dbh, net decay)

## Graphs for operable samples: Old TSR comparison (letter symbols are map GTGs)

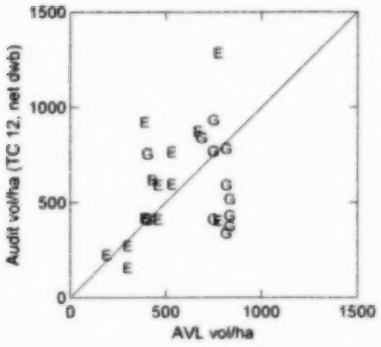



Fig. 19: Audit volume (TC 1&2, 17.5cm+ dbh, net dwb) vs. AVL volume

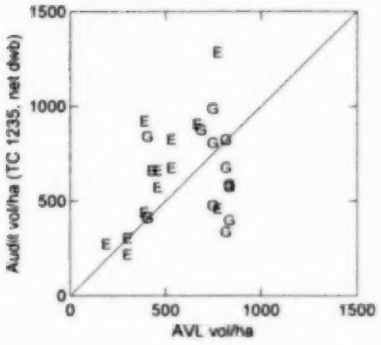



Fig. 20: Audit volume (TC 1,2,3&5, 17.5cm+ dbh, net dwb) vs. AVL volume

## Summary of results for all INOPERABLE (100% inoperable only) samples: VDYP comparison

***Table 13. Means and confidence intervals for VDYP comparison: 100% inoperable samples***

| *Attribute* | *n* | *mean* | *95% CI* | *Sampling error (% of mean)* |
|---|---|---|---|---|
| Inventory vol/ha (VDYP, 17.5cm+ dbh, net dwb) | 14 | 441 | 311 – 570 | 29.4% |
| Audit vol/ha (compiled, TC 1&2, 17.5cm+ dbh, net dwb) | 14 | 487 | 341 – 633 | 30.0% |
| "Ground attribute" vol/ha (VDYP, 17.5cm+ dbh, net dwb) | 11 | 452 | 286 – 617 | 36.7% |
| Ground height (m) | 11 | 29.5 | 21.9 – 37.1 | 25.7% |
| Inventory height (m) | 14 | 28.5 | 24.1 – 32.9 | 15.6% |
| Ground age (yrs) | 11 | 399 | 255 – 543 | 36.1% |
| Inventory age (yrs) | 14 | 264 | 220 – 308 | 16.6% |

***Table 14. Ratios, t-tests and correlations for VDYP comparison: 100% inoperable samples***

| *Attributes compared* | *n* | *Ratio (95% CI)* | *Sampling error % for ratio* | *Mean paired difference (p-value)* | *Correlation (p-value)* |
|---|---|---|---|---|---|
| Audit volume / map volume (TC 1&2, 17.5cm+ dbh, net dwb) | 14 | 1.11<br>0.86 – 1.35 | 22% | 47<br>(0.392) | 0.666<br>(0.009) |
| Audit volume / "ground attribute" vol (TC 1&2, 17.5cm+ dbh, net dwb) ≈ "Model bias" | 11 | 1.17<br>0.95 – 1.39 | 18% | 77<br>(0.089) | 0.867<br>(0.001) |
| "Ground attribute" volume / map volume (TC 1&2, 17.5cm+ dbh, net dwb) ≈ "Attribute bias" | 11 | 1.03<br>0.88 – 1.17 | 14% | 12<br>(0.691) | 0.928<br>(<0.001) |
| Ground height / map height | 11 | 1.05<br>0.60 – 1.50 | 42% | 1.4<br>(0.421) | 0.896<br>(<0.001) |
| Ground age / map age | 11 | 1.57<br>0.75 – 2.39 | 52% | 145<br>(0.022) | 0.592<br>(0.055) |

## Graphs for inoperable samples: VDYP comparison (letter symbols are map GTGs)

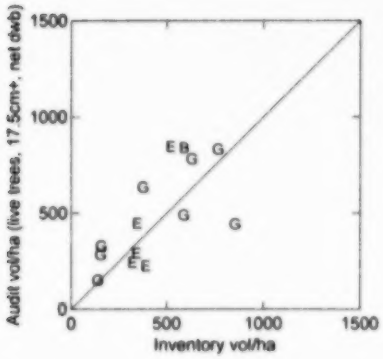



Fig. 21: Audit volume (TC 1&2, 17.5cm+ dbh, net dwb) vs. map volume

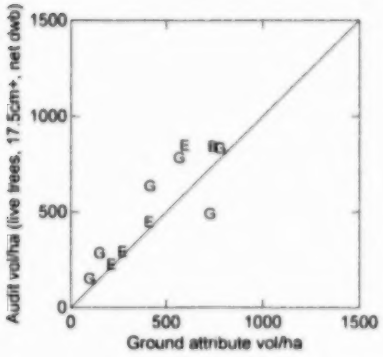



Fig. 22: Audit volume vs. "ground attribute" volume (TC 1&2, 17.5cm+ dbh, net dwb)
≈ "Model bias"

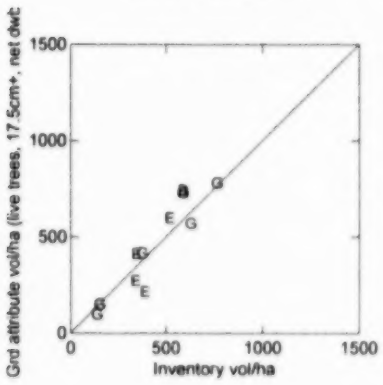



Fig. 23: "Ground attribute" volume vs. map volume (TC 1&2, 17.5cm+ dbh, net dwb)
≈ "Attribute bias"

## Graphs for inoperable samples: VDYP comparison (letter symbols are map GTGs)

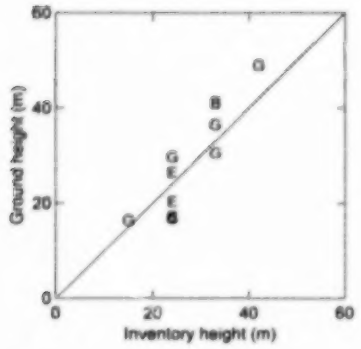



Fig. 24: Ground height vs. map height

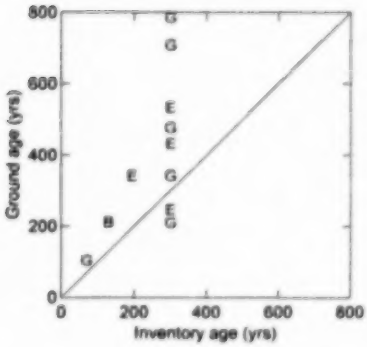



Fig. 25: Ground age vs. map age

## Summary of results for all INOPERABLE (100% inoperable only) samples: Old TSR volume comparison

***Table 15. Means and confidence intervals for old TSR volume comparison: 100% inoperable samples***

| *Attribute* | *n* | *mean* | *95% CI* | *Sampling error (% of mean)* |
|---|---|---|---|---|
| Inventory vol/ha (VDYP, 17.5cm+ dbh, net decay) | 14 | 480 | 342 – 618 | 28.7% |
| "Adjusted" inventory vol/ha (1.09 * inventory vol/ha)[17] | 14 | 523 | 373 – 674 | 28.7% |
| Audit vol/ha (compiled, TC 1&2, 17.5cm+ dbh, net dwb) | 14 | 487 | 341 – 633 | 30.0% |
| Audit vol/ha (compiled, TC 1,2,3&5, 17.5cm+ dbh, net dwb) | 14 | 526 | 380 – 672 | 27.8% |
| AVL vol/ha (17.5cm+ dbh, net dwb, dead potential wood included??) | 11 | 560 | 411 – 709 | 26.6% |

***Table 16. Ratios, t-tests and correlations for old TSR volume comparison: 100% inoperable samples***

| *Attributes compared* | *n* | *Ratio (95% CI)* | *Sampling error % for ratio* | *Mean paired difference (p-value)* | *Correlation (p-value)* |
|---|---|---|---|---|---|
| Audit volume / "adj'd" map volume (TC 1&2, 17.5cm+ dbh, net dwb) | 14 | 0.93<br>0.71 – 1.15 | 24% | -36<br>(0.524) | 0.679<br>(0.008) |
| Audit volume / "adj'd" map volume" (TC 1,2,3&5, 17.5cm+ dbh, net dwb) | 14 | 1.01<br>0.78 – 1.23 | 22% | 3<br>(0.961) | 0.684<br>(0.007) |
| Audit volume / AVL volume (TC 1&2, 17.5cm+ dbh, net dwb) | 11 | 0.90<br>0.66 – 1.14 | 26% | -56<br>(0.385) | 0.599<br>(0.052) |
| Audit volume / AVL volume (TC 1, 2,3&5, 17.5cm+ dbh, net dwb) | 11 | 0.97<br>0.71 – 1.23 | 27% | -17<br>(0.806) | 0.547<br>(0.082) |
| AVL volume (17.5cm+, net dwb) / map volume (VDYP, 17.5cm+ dbh, net decay) | 11 | 1.11<br>0.88 – 1.35 | 21% | 56<br>(0.280) | 0.759<br>(0.007) |

[17] The last TSR report for TFL 19 used a 1.09 ratio adjustment factor to adjust the inventory volumes for waste, breakage and error associated with VDYP. The adjustment factor was developed from the relationship between AVL volumes and VDYP volumes.

## Graphs for inoperable samples: old TSR volume comparison (letter symbols are map GTGs)

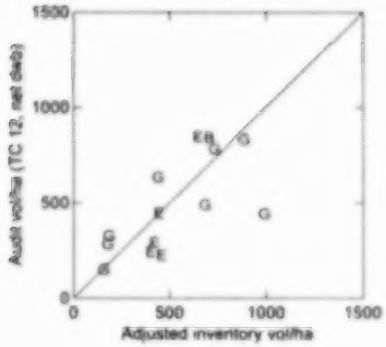



Fig. 26: Audit volume (TC 1&2, 17.5cm+ dbh, net dwb) vs. "adjusted" map volume

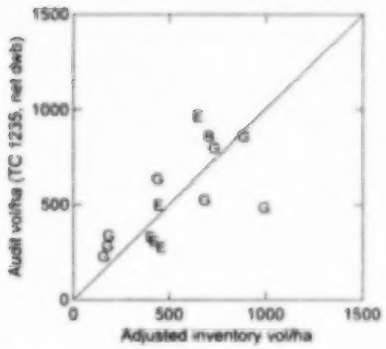



Fig. 27: Audit volume (TC 1,2,3&5, 17.5cm+ dbh, net dwb) vs. "adjusted" map volume"

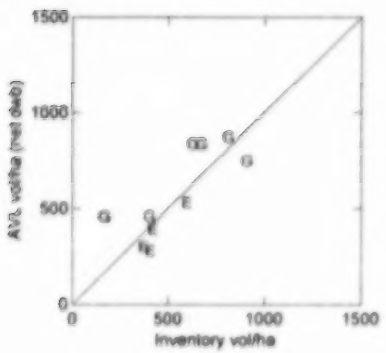



Fig. 28: AVL volume (17.5cm+, net dwb) vs. map volume (VDYP, 17.5cm+ dbh, net decay)

## Graphs for inoperable samples: Old TSR comparison (letter symbols are map GTGs)

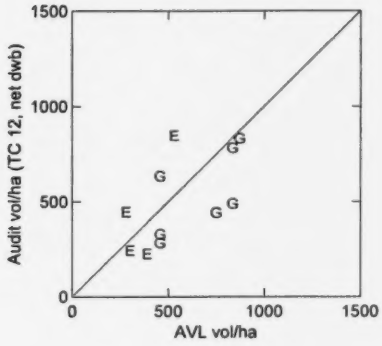



Fig. 29: Audit volume (TC 1&2, 17.5cm+ dbh, net dwb) vs. AVL volume

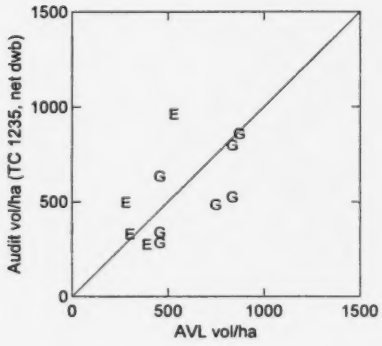



Fig. 30: Audit volume (TC 1,2,3&5, 17.5cm+ dbh, net dwb) vs. AVL volume

## Inventory Classification Assessment: Growth Type Group Comparison

- **58%** of the growth type groups from the inventory (ie. map labels) matched the audit growth type groups; **62%** of the samples matched by leading species.
- For operable or partially operable samples (n=36), 64% of the inventory samples matched the audit growth type groups and 67% of the samples matched by leading species.
- the growth type group distribution for the 50 inventory audit samples is as follows (the bold italic entries on the diagonal in the table indicate a GTG match between the audit and the inventory):

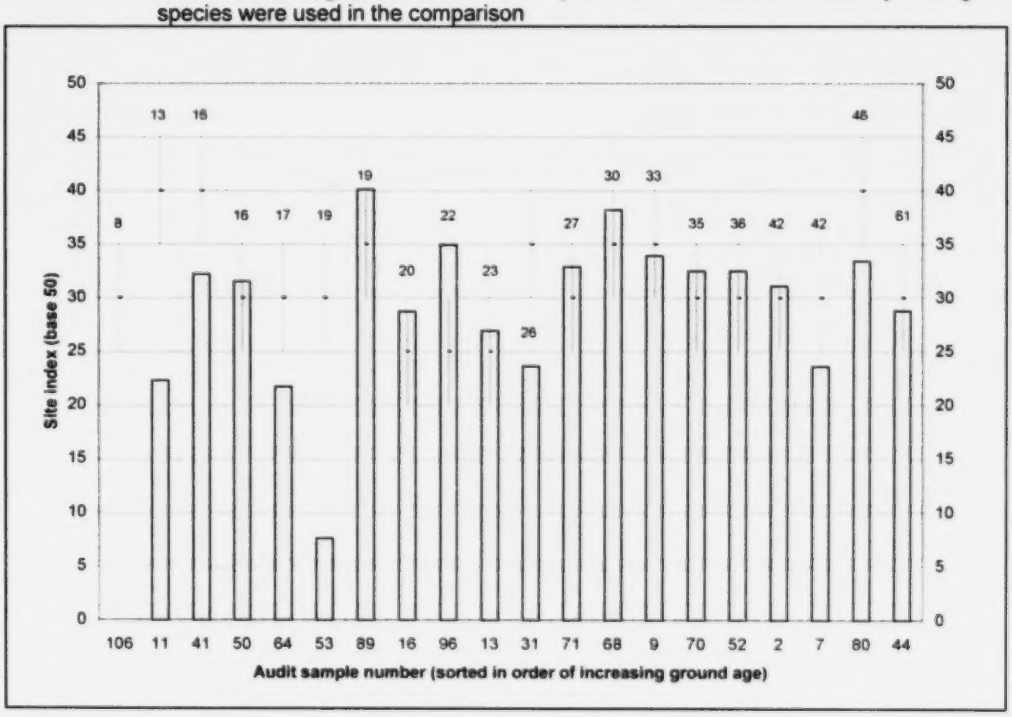
| **Audit GTG** | ***Inventory GTG (columns)*** | | | | | |
|---|---|---|---|---|---|---|
| **(rows)** | B | E | F | G | H | *total* |
| B | ***3*** | 0 | 0 | 1 | 0 | 4 |
| E | 0 | ***11*** | 0 | 6 | 0 | 17 |
| F | 0 | 0 | ***0*** | 2 | 0 | 2 |
| G | 0 | 8 | 0 | ***15*** | 0 | 23 |
| H | 0 | 1 | 0 | 3 | ***0*** | 4 |
| *total* | 3 | 20 | 0 | 27 | 0 | **50** |

***Letter symbols correspond to map label GTG's as follows:***

| | | | |
|---|---|---|---|
| B | *FdCw and FdYc, FdH, FdS* | G | *HFd, HL, HPy, HPw, HPl, HCw, HB, HS* |
| E | *Cw or Yc, CwFd, CwL, CwPy, CwPw, CwPl, CwDecid, CwH* | H | *B, BH, BS* |
| F | *H, HDecid.* | | |

## Immature Site Index Assessment

- Inventory site index provided was based on site class midpoints
- There were 8 samples where the ground leading species did not match the inventory leading species. For 7 of these 8, ground data was also collected for the inventory leading species. The site index comparison was based on data for species that matched the inventory leading species, where available.
- There were 5 samples for which the inventory age was less than 5 years. Since samples for the immature site index assessment should be free-to-grow, regional staff will be looking into how these samples were selected.
- One sample was too young to assess a ground site index (#106). Inventory site index was within 5 m of the audit site index for 10 out of the remaining 19 samples; inventory site index was more than 5m higher than the audit site index for 7 samples and more than 5m lower than the audit SI for 2 samples.
- Notes to interpret graph:
  - shaded bars correspond to ***audit site index*** values
  - tick marks on vertical lines represent ***inventory site index*** (vertical lines have arbitrarily been set at ±5m around site index)
  - numbers at the top of the bars corresponds to ground total age
  - audit site indices use BH age and growth intercept SI where available (from SiteTool)
  - where available, ground site indices for species that matched the inventory leading species were used in the comparison



## Immature Classification Assessment

- Leading species was used to assess the immature classification (exact species composition was not available from the TFL 19 inventory)
- For **45%** of the samples, the leading species from the inventory matched the audit leading species.
- The leading species distribution for the 20 immature inventory audit samples is as follows (the bold italic entries on the diagonal in the table indicate a match between the audit and the inventory):

| **Audit leading spp** | ***Inventory leading species (columns)*** | | | | |
|---|---|---|---|---|---|
| **(rows)** | Fd | Hw | Ba | Dr | *total* |
| Fd | ***3*** | 1 | 0 | 0 | 4 |
| Hw | 3 | ***5*** | 4 | 0 | 12 |
| Ba | 0 | 1 | ***0*** | 0 | 1 |
| Dr | 0 | 2 | 0 | ***1*** | 3 |
| *total* | 6 | 9 | 4 | 1 | **20** |

## *Analysis Notes:*

*Background*

- All volumes reported are in $m^3$/ha. Utilization is as indicated. TC 1&2 are live trees; TC 1,2,3&5 are live trees plus dead potential and vets.
- In the current TSR, analysis unit volumes will be based on VDYP volumes net dwb. Hence, this is the basis for comparison for the audit.
- The old TSR volumes were also examined in the audit (see note below). The comparisons looked at the "adjusted" VDYP volumes for all samples and the AVL volumes (from which the adjustment factor was presumably derived).
- As per last TSR report, these VDYP volumes are "adjusted" by a 1.09 ratio factor to generate volumes net dwb. This adjustment factor was developed based on the ratio of AVL volumes to VDYP volumes, for polygons where AVL volumes were available. The AVL volumes were 17.5cm+ dbh, net dwb, but not all stands types had a volume line assigned. It was assumed that AVL volumes included dead potential volume. This analysis compares AVL volumes with audit volumes for live trees only and audit volumes for live trees, DP and vets.
- Inventory age and height were from class midpoints.
- A number of polygons had "split" operability. These samples were analyzed both ways, that is, as operable and as inoperable (eg. "100% operable only", "operable including partially operable").

*Observations*

- The VDYP inventory volume (net dwb), which is the basis for the inventory volume in the current TSR, appears accurate. However, this apparent accuracy may be the result of rather large compensating errors (i.e. the model tends to underestimate volume whereas the attributes tend to overestimate volume). Note that ground heights and/or ages were not available for 10 of the 50 samples. Ground attribute volume could not be computed for these 10 samples hence any conclusions regarding model and attribute error may be biased.
- The same general trends seen in the overall VDYP inventory volumes were also observed in the operable portion of the inventory.
- When the volumes used in the last TSR analysis were examined, the analysis suggested that the "adjusted inventory" overestimated the volume in TFL 19. The adjustment ratio of 1.09 used in the last TSR appears to be a potential cause of the volume overestimation. The overestimation caused by the adjustment ratio is particularly significant in the hemlock leading types.
- Although the AVL volumes in TFL 19 appear reasonable (compared with the audit volumes), they appear to overestimate the volume in hemlock types and underestimate the volume in cedar types.